situated at the upper part of the head as to admit of the animal's breathing while only a small portion of its head is above the water. In its descent through the skull, between the cranial and facial bones, the tube is divided by a thin plate of bone into two nasal canals, which form, below this partition, a single muscular tube opening at its lower part into the pharynx by a constricted aperture, through which the larynx projects upwards quite through the pharynx, dividing it into two channels. A series of pouches, five in number, capable of great dilatation, and provided with a muscular apparatus for retaining or expelling their contents, communicate by large orifices with the nasal canals, and appear to correspond in situation with the antra, frontal sinuses and ethmoid cells. The author gives a minute anatomical description of these muscles, and an account of their modes of action; the adjustments of the apparatus being such that the outer passage may be closed or opened above or below the anterior pouches. When the outer passage is closed, the posterior pouches can be distended and the anterior emptied; while the converse may be effected when the passage is open. The use of the pouches appears to be to buoy up the head, so that on the porpoise rising from deep water, the opening for breathing comes first to the surface and admits of the animal's sleeping in that position, while its whole body remains immersed in the water.

"On Motion in the Lumbar Division of the Spine in Birds." By George Oakley Fleming, M.D., F.L.S. Communicated by Thomas Bell, Esq., F.R.S.

The author gives quotations from the works of Cuvier, Blumenbach, Tiedemann, Macartney, Vicq d'Azyr, Carus, Earle, and Roget, in proof of its being the prevalent opinion among comparative physiologists that the dorsal and lumbar portions of the spine form altogether a rigid structure, not admitting of the least perceptible flexion. But from his observations of the form of the articulating surfaces of the lumbar vertebræ, which appear to be adapted to lateral motion, the author was led to conclude that, although flexion in the mesial plane is effectually prevented, some degree of lateral flexion actually takes place. The number of articulations in this part of the spine, he observes, varies in different birds: thus in the sea-gull, there are several articulations in the dorsal and lumbar portions; while, in the peacock, there is only one moveable vertebra; the remaining dorsal being united together, and all the lumbar vertebræ being consolidated and anchylosed with the sacrum; thus forming two firm and immoveable pieces between which the moveable vertebra is placed. The flexion of the spine forwards is prevented by the great breadth of the spinous processes and their projections at right angles to the bodies of the vertebræ; and frequently also by the addition of a number of thin, flat long bones which are applied by their flat surfaces on each side of the spinous processes; and also by strong flat ligaments, situated between each spinous process, like the ligamentum nuchæ of herbivorous quadrupeds. For the purpose of guarding against pressure on the spinal cord during the lateral flexion of

this part of the spine, the spinal canal is enlarged laterally at the centres of motion. The paper is illustrated by drawings of the parts described.

March 19, 1846.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"Investigation of the Power consumed in overcoming the Inertia of Railway Trains, and of the Resistance of the Air to the motion of Railway Trains at high velocities." By P. W. Barlow, Esq., F.R.S., M.I.C.E.

The object of the author in this inquiry is to obtain a more correct knowledge than has hitherto been possessed of the resistances which the air opposes to the motion of locomotive engines at great velocities, and of the loss of force arising from increased back pressure and the imperfect action of the steam. For this purpose he institutes a comparison between the velocities actually acquired by railway trains with those which the theory of accelerated motion would have assigned; and his experiments are made not only on trains propelled by a locomotive engine, but also on those moving on the atmospheric railway, which latter affords valuable results, inasmuch as the tractive force is not subject to the losses at high velocities necessarily incident to locomotive engines. A table is given of the theoretical velocities resulting from calculation founded on the dynamical law of constant accelerating forces, in the case of trains of various weights, impelled by different tractive forces, moving from a state of rest; and is followed by another table of the observed velocities in Mr. Stephenson's experiment on the Dalkey line; the result of the comparison being that in a distance of one mile and a quarter, the loss of velocity is about one-half of the observed velocity.

A series of experiments on locomotive lines is next related; but the comparison is less satisfactory than in the former case, because the tractive force cannot be so accurately estimated; it is however sufficiently so to establish the fact, that the power lost by the locomotive engine below the speed of thirty miles per hour is so small as to be scarcely appreciable, and that the time and power which are absorbed in putting a railway train in motion is almost entirely required to overcome the inertia of the train, and does not arise from any loss or imperfection of the engine. It appears, from these experiments, that above one-fifth of the whole power exerted is consumed in putting the train in motion at the observed velocity. The author then enters into some general remarks on the effects arising from this source of loss of power, and the practical application of the knowledge thus obtained. In the atmospheric railway, he finds that the tractive force of a fifteen-inch pipe is so small (being less than half that of a locomotive engine), that the time of overcoming the inertia must limit the amount of traffic which can be carried on